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Curriculum Guideline

Science

Intermediate and
Senior Divisions

1986

Part ~~Four~~ 9: Senior Biology
- Grade 11, General

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Introduction

The Parts of the Guideline

This document is part 4 of a nine-part curriculum guideline that outlines the science program and policy for the Intermediate and Senior Divisions in Ontario Schools and describes the science courses that can be offered. The term guideline refers to the entire set of nine parts.

This part must be read and implemented in conjunction with Part 1: Science Program and Policy. When implementing the Biology courses that are described in this document, teachers are to incorporate the many features outlined in part 1 which will enable teachers to interpret the overall intent and expectations of the Ministry of Education in the science program. The table of contents for part 1 is given in appendix A at the end of this document so that the reader may have ready access to the list of chapters and topics therein.

The provincial science program for the Intermediate and Senior Divisions comprises the courses described in parts 2-9 and these come under the policy and framework set forth in part 1. The entire science guideline consists of the following nine parts:

Part 1: Science Program and Policy

Part 2: Intermediate Science
- Grades 7 and 8
- Grades 9 and 10, General Level
- Grades 9 and 10, Advanced Level

Part 3: Basic-Level Science

- Grades 9 to 12, Basic Level

Part 4: Senior Biology

- Grade 11, General and Advanced Levels
- Ontario Academic Course

Part 5: Senior Chemistry

- Grade 11, General and Advanced Levels
- Ontario Academic Course

Part 6: Senior Physics and Technological Science

- Grade 12, General and Advanced Levels
- Grade 12, Technological Science
- Ontario Academic Course

Part 7: Environmental Science

- Grades 10 to 12, General Level
- Grades 10 and 12, Advanced Level

Part 8: Geology

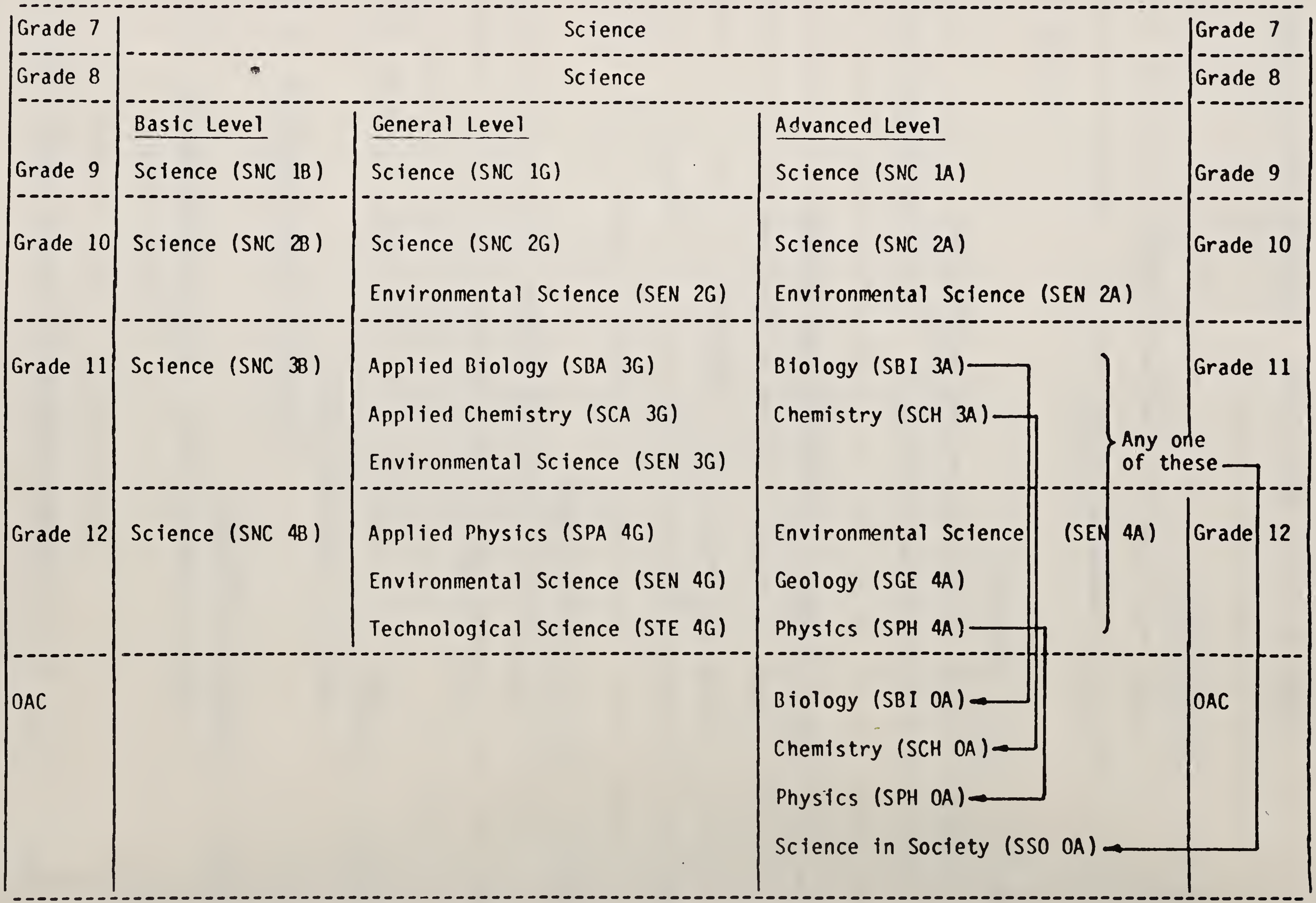
- Grade 12, Advanced Level

Part 9: Science in Society

- Ontario Acadmic Course

Note: A list of the science courses with their course codes is given in appendix B.

Authorized Science Guideline Courses, Intermediate and Senior Divisions



	Basic Level	General Level	Advanced Level		
Grade 7	Science				Grade 7
Grade 8	Science				Grade 8
Grade 9	Science (SNC 1B)	Science (SNC 1G)	Science (SNC 1A)		Grade 9
Grade 10	Science (SNC 2B)	Science (SNC 2G) Environmental Science (SEN 2G)	Science (SNC 2A) Environmental Science (SEN 2A)		Grade 10
Grade 11	Science (SNC 3B)	Applied Biology (SBA 3G) Applied Chemistry (SCA 3G) Environmental Science (SEN 3G)	Biology (SBI 3A) Chemistry (SCH 3A)	Any one of these	Grade 11
Grade 12	Science (SNC 4B)	Applied Physics (SPA 4G) Environmental Science (SEN 4G) Technological Science (STE 4G)	Environmental Science (SEN 4A) Geology (SGE 4A) Physics (SPH 4A)		Grade 12
OAC			Biology (SBI OA) Chemistry (SCH OA) Physics (SPH OA) Science in Society (SSO OA)		OAC

Note: Prerequisites to the OACs are shown by arrows

Features That Apply Across the Science Program

Part 1 of the guideline specifies a great number of features that are to be integrated into the design of the science program in the Intermediate and Senior Divisions. There are too many of these features to describe in full in each of parts 2-9, but the following will give the reader some idea of the kinds of features that are mentioned. They include:

- identification of the science courses that are mandatory towards the earning of the Ontario Secondary School Diploma;
- the list of science courses that are prerequisite to other science courses;
- the policy regarding mandatory student activities in the science laboratory;
- the list of aims of the science curriculum and the various emphases that may be used to blend such aims with scientific content;
- policy governing time allocations for units of study and the order in which core and optional units may be taught;
- stipulations about locally designed units;
- suggestions about preferred routes that students might take through the science program;
- policy regarding the introduction of non-guideline courses, which are subject to approval by the Ministry of Education;
- recommendations related to exceptional students, individualized instruction, life management skills, career awareness, the role and evaluation of language in science courses, and a balanced perspective on the role of both girls and boys in science;
- introduction and handling of sensitive issues;
- specific suggestions about resources for the teaching of science;

- specific suggestions about resources for the teaching of science;
- ideas about different modes of delivering science courses including the co-operative education mode;
- the significant role to be played by measurement and metric units in science courses;
- stipulations related to the treatment of symbols, significant digits, and mathematical problem solving;
- specific directions about safety in science courses;
- policy and principles pertaining to the evaluation of student achievement;
- differences in the treatment of science courses at the three levels of difficulty;
- many suggestions about implementing the science program.

It cannot be emphasized strongly enough that teachers of science must integrate the policy and recommendations outlined in part 1 with the teaching of science and cannot simply rely on the course descriptions given in parts 2-9 of the guideline.

The Science Curriculum Continuum

By the time students have reached the Senior Division, they will have experienced an integrative approach to science with a number of other subject areas in the Primary and Junior Divisions, and then an exploratory approach to a mosaic of science disciplines - biology, chemistry, physics, and environmental science - in the Intermediate Division. In the Senior Division, they are provided with a specialization approach where the science courses deal with a single discipline at a time.

Although these approaches - integration, exploration, and specialization - provide different ways of dealing with the subject, the intention is to ensure that there is a continuum throughout the years. For instance, it is apparent that the applied biology course in this document is a further extension of the Intermediate science courses, particularly for those units of study dealing with the life sciences in the general-level Grades 9 and 10 courses. Similarly, the two advanced-level courses in biology, the Grade 11 course and the OAC, build on the life science units of the advanced-level courses in the Intermediate years.

For many students enrolled in general-level senior science, particularly those who intend to take health sciences at the colleges of applied arts technology, it is recommended that they include applied biology in their secondary school program. For those who wish to attend university and continue further studies in biology, it is recommended that they include Grade 11 advanced-level biology and the biology OAC. A continuum is provided in these different streams to ensure that earlier courses provide a foundation for later courses.

Biology teachers should be aware of the subject matter contained in the life science units of the Intermediate Division courses and also how senior biology relates to other senior division science courses.

In all courses the core units and the prescribed number of optional units, if any, are to be included. The time allocation for each unit of study should act as a guide in helping teachers devote a proportionate amount of time to each of the units in a course. This is important in view of the continuum from one course to another and to post-secondary science programs.

Compulsory and Prerequisite Courses

In each of Grades 7 and 8, students are required to enrol in a science course having instructional time of at least eighty hours.

In the secondary school program two science courses are normally required among the compulsory subjects that are necessary for the earning of the Ontario Secondary School Diploma. One of the compulsory science courses required shall be any science course at the basic level or any Grade 9 science course. Such a compulsory course must be one described in part 2 or 3 of this science curriculum guideline. While there is no specific stipulation about the second compulsory science course, it is recommended that students first take a Grade 9 science course, followed by a Grade 10 science and/or environmental science course, thus obtaining at least two science credits towards the diploma, and then proceed to take Senior Division science courses as desired.

In the secondary school program other options are open, and principals and teachers should advise students of such options. (See OSIS, section 4.10, notes (d) and (e), and also part 1 of this science guideline, sections 8.7 and 8.9.)

When students enrol in a Grade 11 biology or applied biology course, it should be expected that they would normally have completed a science course in each of Grades 8 to 10 in preparation for the senior course.

Biology, Grade 11, Advanced Level is a prerequisite to Biology, OAC. Principals may waive this requirement if the student has taken a course that may be considered to be equivalent to the prerequisite or if there is good reason to believe that the student can adequately cope with the biology OAC in preparation for university.

Curriculum Emphases

It is recommended that teachers organize each of the courses described in this document around a particular curriculum emphasis or set of emphases. Such emphases give the curriculum a special focus that can be introduced in addition to the content and processes outlined in the courses. This approach is discussed in "Curriculum Emphases - Blending Curriculum Aims With Content", in section 11 of part 1 of this science guideline.

Typical emphases that might be developed in these courses include the following: the holistic nature of biology, the nature of science, science as a human endeavour, the relationship between science and society, and the development of scientific skills. While every unit has some reference to each of the above emphases, a particular emphasis, which may be stressed throughout an entire course or for one or more units at a time, should be highlighted so that it becomes a focal or integrating theme.

Student Activities

In each unit of study there is a section entitled "Student Activities". This section indicates the practical or laboratory work required of the students. Teachers may substitute equivalent activities where appropriate. Those activities that are to be actually performed by the students themselves are marked with asterisks. If time and circumstances permit, the teacher should encourage the students to do some or all of the unmarked activities as well. However, such activities may be demonstrated by a student or the teacher, or may be discussed using a textbook, film, computer program, or other learning material as a resource. In any event, the scientific concepts and principles related to such unmarked activities, and identified in the objectives of the unit of study, shall be considered to be part of the prescribed course.

Generally, the best approach to the teaching of science is to ensure that the content develops directly from related student activities. In each unit of study, the skills and processes of scientific work should be presented as the central component, from which the subject matter, applications, and implications emerge.

Some of the student activities in these courses require the students to dissect a mammal or another vertebrate. Appropriate dissection skills, safety considerations and attitudes must be emphasized during these activities. The number of organisms used for dissections should be kept to a minimum as it is not appropriate to dissect a new vertebrate for each organ system that is studied. Common mammals that can be used for dissection include the white rat and fetal pig. A fish or a frog could be used as an alternate vertebrate organism. The dissection could be done at the end of the study of the various vertebrate systems or it could be done as each organ system is completed. In the latter case provisions must be made to maintain the specimens over a longer period of time. In some cases animal organs can be obtained from an abattoir and these can be used to supplement the whole organism dissection. Wild animals or road kills should not be dissected or brought into the school.

Cross References

In the descriptions of each unit of study in the courses outlined in this document, there are cross references shown in brackets. These are not exhaustive and are included to show some examples of related parts further on in the unit.

Introduction

Units of Study

The following chart provides an overview of the units of study in this course and indicates the time to be allocated to each unit.

Applied Biology, Grade 11, General level (SBA 3G)

Units	Time Allocations	Page
Core		
1. Dietary Input	14 h	15
2. Alimentary and Excretory Systems	15 h	20
3. Communication Network - Sensory Organs	15 h	27
4. Respiratory/Cardiovascular Systems	14 h	35
5. Genetics and Reproduction	14 h	42
6. Waste Management	14 h	48
	86 h	
Optional Select any combination of complete units to total 24 h		
1. Home Gardening	12 h	55
2. Skin	12 h	61
3. Bones and Muscle - Body Support	12 h	67
4. White Rat Dissection	6 h	75
5. Humans and The Environment	12 h } 24 h	82
6. Behaviour and The Central Nervous System	6 h	89
7. Locally Designed Unit	6 or 12 h	98
	110 h	

Special Features of the Grade 11 Applied Biology course

1. The following is the formal name and code for this course: Applied Biology, Grade 11, General Level (SBA 3G). It is designed to introduce students to a study of human biology and deals with the input, internal processing, and output of the body. The impact of humans on the environment, both in terms of their waste and other human activities, is also considered in order to provide a balanced treatment of this area of study.

2. The input, processor and output components of the human body provide a framework for this course. These components include the quality and quantity of the input to the body, the efficiency of the body's processing and communication mechanisms, and the effectiveness of the treatment of waste materials prior to their returning to the environment.

3. Three of the units of study (CU1, CU4, CU5) have areas of potential overlap with courses in Family Studies and Health and Physical Education. It is strongly recommended that the departments in each school concerned with the possible overlap meet to cooperate in the planning of these units so that the various courses are complementary. This Applied Biology course should emphasize laboratory investigations and the basic biological knowledge that results from these investigations.

4. The first aid components introduced in this course should emphasize an understanding of the biological principles which are the basis of the various techniques which are examined. It is highly recommended that demonstrations and instruction in first aid be left to qualified instructors. Students should not be expected to perform the various techniques.

5. The interrelationship between science and society is important in an applied science course. The applications and societal implications sections of each unit are therefore important features of this course so that biology is seen to be a relevant, human endeavour. Students should be aware of the ways

in which biological principles and applications influence their lives and those of the society in which they live.

6. It is intended that the overall evaluation of student achievement will reflect the primary emphasis on practical laboratory work and include other components as required.

7. The optional unit, entitled "Locally Designed Unit", may be used to introduce a new area of biology not described in the guideline, to include new work that expands on previous topics in the course, or to extend the time allocations for the core units by an additional 6 or 12 hours.

Applied Biology, Grade 11, General Level (SBA 3G)

Core Unit 1: Dietary Input Time: 14 h

Some of the more fundamental and important decisions made by people each day are related to food and beverage consumption. Adolescents should develop an understanding of the ingredients of food and the role that these ingredients play in the human body. They should understand the importance of selecting foods that provide for a balance of nutrients in the diet. The student activities should form the focus of this unit and the appropriate content should follow from each activity. The teacher should consult with teachers of family studies to ensure that the two programs are complementary.

This unit may be divided into topics such as the following:

- Ingredients in food
- Nutrient tests
- Vitamin C analysis

1. Objectives

Attitudes. Students will be encouraged to develop:

a) a critical attitude towards the quality and quantity of the foods they consume (3c);

b) an awareness that they will live healthier lives if they develop proper eating habits (3a);

c) an appreciation that scientific experiments can provide information concerning the ingredients in foods (2a-2e).

Skills. Students will have the opportunity to develop skill in:

a) classifying both the nutrients and additives in food (2a);

b) analysing foods for the presence of various nutrients (2b);

c) controlling variables while measuring quantitatively the amount of vitamin C found in selected foods (2d);

d) plotting a histogram indicating the amount of vitamin C in various fruits, vegetables and their juices (2d);

e) keeping organized records of experimental work and daily food, drink, and energy consumption (2f).

Knowledge. Students will be expected to:

a) state the major biochemical nutrients in foods, for example, protein, carbohydrates, fats, water, vitamins and minerals, and indicate their function in the body (2b);

b) name the basic chemical components of protein, starch, and fat and list food sources rich in each;

c) describe the relationship between the way ingredients are listed on labels and their mass (2a);

d) describe body requirements for a balanced diet based on biochemical needs and indicate how this might change based on different life styles;

e) describe the importance of food fibre;

f) compare the energy content of a variety of foods (2e);

g) explain the effects of cooking and preserving on the nutrient content of foods (4e).

2. Student Activities

Students are to:

- *a) classify the ingredients in packaged foods based on information on the label (8a, 8b);
- *b) perform chemical tests to identify the presence of protein, starch, and sugar, in various food samples (6a-6c);
- c) analyse a given unknown mixture for the presence of nutrients;
- *d) determine by experiment the amount of vitamin C in fruits, vegetables and their juices (6c, 8c);
- e) use a calorimeter to determine the relative energy content of a variety of foods (6c);
- *f) analyse a student's life style in the form of a report, based on a simulated record of the student's daily food and energy intake and energy output (8e).

*See the subsection entitled "Student Activities" on page 10.

3. Applications

- a) A knowledge of food input and energy output can help people to develop appropriate eating habits.
- b) Reading labels carefully may enable the individual to avoid consuming unwanted additives.
- c) Using criteria based on the results of scientific investigations in selecting and purchasing food should allow students to make informed consumer decisions.

4. Societal Implications

- a) A society conscious of the nutrient value of foods should result in a healthier population.
- b) Many health disorders can be controlled by diet (e.g., diabetes).

c) Some fad diets may cause serious long term negative effects.

d) Food additives such as salt may accentuate health problems in some individuals.

e) The processing and preserving industry provides a variety of careers for people with knowledge and skills related to the analysis of nutrients in foods.

5. Evaluation of Student Achievement

At least 50 per cent of the term mark for this unit is to be based on students':

a) laboratory work (e.g., analysis of food for vitamin C);

b) ability to classify the ingredients in packaged foods;

c) ability to organize experiments and laboratory reports.

6. Safety Considerations

a) Protective eyewear should be worn when heating solutions.

b) Indicators used for chemical tests should be handled with care.

c) Food samples used in experiments should not be consumed and should be disposed of immediately after use.

7. Possible Extensions

Some students might:

a) investigate some of the foods used in herbal medicines and remedies;

b) list and compare various common food preparation methods with respect to the ultimate nutritional value of food;

c) do a library research project on a diet related topic such as obesity, anorexia nervosa, fad diets, food allergies, food additives, or health foods;

d) use a computer programme to evaluate daily food and energy intake;

e) examine and analyse special diets required for persons with ulcers, gall bladder problems and high cholesterol levels;

f) examine procedures used by government laboratories in the analysis and control of foods sold on the market.

8. Some Teaching Suggestions

a) The laws governing the listing of food ingredients on labels should be stressed.

b) Students should be encouraged to bring a variety of food labels to the classroom. Students should be given the opportunity to design their own classification system for the ingredients listed on the labels.

c) Students should be made aware of experimental error by comparing the results of their vitamin C analysis with others.

d) The ability of students to perform various laboratory skills should be evaluated during the laboratory activities.

e) Students should be encouraged to keep accurate records.

Core Unit 2: Alimentary and Excretory Systems Time: 15 h

The nutrients in the diet are digested and absorbed into the body and the left-over wastes are excreted or eliminated. An understanding of the components of the body that accomplish these functions is important for every individual. The results of student laboratory work can provide a basis for this understanding.

This unit may be divided into topics such as the following:

- Mouth
- Esophagus
- Stomach
- Intestine
- Excretory system

1. Objectives

Attitudes. Students will be encouraged to develop:

a) an appreciation of the relationship of the structure of the digestive system of various organisms to their diet (2a, 2f);

b) concern for the disposal and treatment of waste;

c) a curiosity about the role of stress in human body functioning and its relationship to lifestyle (4a);

d) critical mindedness regarding the use of easily obtained medicines for digestive and excretory disorders (3c).

Skills. Students will have the opportunity to develop skill in:

a) observing morphological adaptations such as tooth structure, and length of the digestive system, and describing the the relationship of these to an animal's diet (2a);

b) formulating hypotheses and controlling variables in an experiment examining enzyme properties (2b);

c) interpreting observations that relate to the specific conditions under which enzymes break down macromolecules (2b, 2c);

d) reporting investigations in a way that will enable others to repeat them;

e) using dissection instruments and proper technique during the dissection of a vertebrate (2f);

f) performing a simple acid-base titration (2g);

g) measuring the quantities of materials required for simple titrations (2g).

Knowledge. Students will be expected to:

a) describe the types, basic structure, and functions of human teeth (2a);

b) describe the methods, and need for proper oral hygiene (2a);

c) outline the cause, symptoms, and treatment, of selected disorders of the digestive system (e.g., tooth cavities, gingivitis, periodontal disease, halitosis, gastric ulcer, hiatus hernia, heartburn, duodenal ulcer, diabetes, peritonitis, appendicitis, hepatitis);

d) contrast or compare human dentition with that of other vertebrates (2a);

e) state the location of the salivary glands and list the components and functions of saliva (2c);

f) describe the optimum condition for the operation of some digestive enzymes such as amylase or pepsin (2b, 2c);

g) describe the structure and function of each of the following components of the digestive system: mouth, tongue, epiglottis, esophagus, stomach, intestine, liver, gall bladder, pancreas, appendix, rectum, anus (2f);

h) describe the mechanics involved in swallowing and peristaltic movement throughout the digestive tract (2f);

i) describe how substances such as alcohol, aspirin and nutrients are absorbed through the stomach or small intestine (2d);

j) state the function of bile (2e);

k) identify the parts of the digestive system and excretory system shown in a vertebrate dissection (2f);

l) describe the structure and function of the kidneys, ureters, urinary bladder and urethra (2f);

m) identify the major components of urine and describe their relationships to the diet;

n) outline the cause, symptoms, and possible treatment for urinary tract infections, and kidney stones;

o) describe the effect of stress on the alimentary and excretory systems and suggest methods of coping and reducing the stress level (8h).

2. Student Activities

Students are to:

*a) observe the structure of human teeth by examining models and/or diagrams and compare this to the structure and function of the teeth of other vertebrates (8c, 8e);

*b) design a properly controlled experiment to observe the effects of pepsin and hydrochloric acid on egg albumin under a variety of conditions (6a, 8a);

c) conduct an experiment to investigate the conditions under which amylase digests starch and test the products with Benedict's solution, Fehling's solution, or a glucose test strip (6a);

d) construct a model of the small intestine to illustrate how convolutions and villi increase the surface area of the small intestine for nutrient absorption (8c, 8g);

e) demonstrate the process of emulsification by adding some commercially obtained bile to a layer of cooking oil on water (6a, 8f);

*f) perform a vertebrate dissection to observe the parts of the digestive and excretory systems (6b, 8e);

g) titrate various antacids with hydrochloric acid to determine the effectiveness of each (6a).

*See the subsection entitled "Student Activities" on page 10.

3. Applications

a) A knowledge of the location and function of body components helps in the understanding of health and disease.

b) Recognizing an abnormal condition gives the individual an opportunity to seek early treatment and relief.

c) A basic knowledge of over-the-counter drugs specific for digestive or excretory disorders is necessary for proper use.

d) Proper hygiene and diet are important components of good health.

e) Regular medical and dental check ups are important as preventative measures in the maintenance of good health.

4. Societal Implications

a) Prevention and early recognition of body disorders results in more productive individuals.

b) A variety of occupations in the health sciences are available for students with interests related to the digestive/excretory systems.

5. Evaluation of Student Achievement

At least 50 per cent of the term mark for this unit is to be based on students':

a) reports of student activities;

b) facility with, and understanding of laboratory apparatus and techniques;

c) ability to identify of the parts of the digestion and excretory systems shown in a vertebrate dissection.

6. Safety Considerations

a) The chemicals used in this unit such as Benedict's solution, Fehling's solution, pepsin, and hydrochloric acid, should be treated with caution.

b) Protective eyewear and gloves should be worn during a dissection. All preserved specimens should be thoroughly washed in tap water prior to use. The laboratory should be well ventilated during the dissection.

c) Students should be aware of possible allergic reactions to the chemicals used in this unit.

7. Possible Extensions

Some students might:

a) investigate recent developments in modern dental techniques;

b) investigate modern diagnostic techniques for gastrointestinal disorders (e.g., ultrasound, X-rays using radio-opaque dyes);

c) visit a hospital laboratory;

d) examine newspapers and magazines for articles concerning the use or misuse of laxatives and/or antacids;

e) perform a urinalysis using a urinalysis Combistik available from a pharmacy to test for the presence of glucose, ketones, bilirubin, blood, protein, and to determine pH.

8. Some Teaching Suggestions

a) In keeping with the theme of the course, teachers should emphasize that this unit begins the study of the input of nutrients to the human body.

b) Recording observations from experimental work in tabular form should be emphasized in this unit.

c) The relationship between structure of an organ and its function should be emphasized.

e) Since this is an applied biology course focusing on the human, the vertebrate dissection should be related to human anatomy and function.

f) Detergent may be used if bile is not available to demonstrate emulsification. The effect of detergent can be related to everyday examples (e.g., washing hair, washing dishes).

g) The large surface area of the intestine can be illustrated by relating it to the surface area of a piece of paper folded into a fan.

h) Stressful situations in the home, at school or work and ways of dealing with this stress should be discussed.

i) A pharmacist can be invited to discuss the variety of over-the-counter drugs which are available.

Core Unit 3: Communication Network - Sensory Organs Time: 15 h

The human body is equipped with a variety of sensory mechanisms that permit it to monitor environmental stimuli, and to interpret and process them so that it can respond in an appropriate manner. The individual's sensory responses can be demonstrated through a variety of simple activities which illustrate the uniqueness of every person, particularly in terms of the interpretation of stimuli. The nervous system assisted by the five sense organs - the eyes, nose, skin, ear and tongue - co-ordinates a network of responses that keeps the systems of the body functioning together.

This unit may be divided into topics such as the following:

- Eye
- Ear
- Chemoreceptors
- Touch
- Reflexes
- Central nervous system

1. Objectives

Attitudes. Students will be encouraged to develop:

a) curiosity in investigating the characteristics of their eyes, for example, visual field, near or far-sightedness, and visual acuity (2a);

b) a respect for people with hearing and visual handicaps as individuals capable of leading productive lives (4a);

c) an appreciation for the use of technology in treating sensory malfunctions, for example, contact lenses, hearing aids and laser surgery (4a);

d) a respect for animals used in assisting the handicapped to overcome physical handicaps (e.g., seeing eye dogs);

e) a co-operative attitude in assisting individuals with sensory disabilities;

f) an appreciation for the protection of the sensory receptors against environmental over-stimulation (3e, 4c);

g) a respect for the right of an individual to a quiet personal space (4d).

Skills. Students will have the opportunity to develop skill in:

a) determining visual acuity using the Snellen's eye chart (2a);

b) accurately recording, organizing and interpreting data related to personal characteristics, for example, vision, taste, touch, and reaction time (2a, 2d-2g);

c) drawing ray diagrams to illustrate the path of light rays through the eye for near and far vision (2b);

d) observing and identifying the near point, blind spot, and use of a perimeter for the determination of visual field (2a);

e) dissecting the eye of a cow or sheep (2b);

f) mapping the tongue for the major areas of taste such as sour, sweet, salt and bitter (2e);

g) locating several reflex areas in the body, for example, below the kneecap of a bent knee, and inside the inner elbow (2g).

Knowledge. Students will be expected to:

a) describe the parts of a control system (e.g., stimulus, receptor, conductor, interpreter, effector, response);

b) locate in a dissection and state the function of the major parts of the eye and associated structures (2b);

c) describe the position of the image in the eye in the case of near and far sightedness and explain how additional lenses can correct the disorder (2a);

d) distinguish between the location and function of rods and cones in the retina (2a);

e) explain how the use of different lenses such as concave, convex, polarized, or coloured (red, blue, yellow) may affect vision (2b);

f) explain the term optical illusion and give a specific example (2c);

g) describe proper eye care and hygiene including safety precautions, and first aid procedures in case of injuries (e.g., the use of eye wash stations in laboratories, the significance of proper reading light, proper sanitation for contact lenses, the use of commercial eye solutions, the importance of safety glasses in workshops);

h) describe common disorders of the eye, for example, conjunctivitis, cross-eyes, cataracts, and astigmatism, and indicate their possible treatment (2a, 2h);

i) define the term decibel and relate it to the range and sensitivity in human hearing and also to the potential hazards of loud sounds from earphones, and instrument speakers (2d, 3e, 4d);

j) describe the function of the major parts of the human ear including the pinna, eardrum, hammer, anvil, stirrup, cochlea, semicircular canals, auditory nerve, and eustachian tube (2d);

k) explain the dual role of the ear for hearing and balance control (2d);

l) describe the interdependence of taste and smell in sensory perception (2e);

m) state the areas of the body most and least sensitive to touch, heat, and cold (2f, 2i);

n) define the terms reflex and reaction time and describe how they are affected by fatigue and drugs such as alcohol (2g);

o) recall that the function of the nervous system is to keep the life support systems functioning together;

p) identify the basic regions of the vertebrate brain and state their function.

2. Student Activities

Students are to:

*a) (i) test visual acuity using Snellen's eye chart;

(ii) perform experiments to investigate eye characteristics (e.g., red-green colour-blindness, depth perception, peripheral vision, pupil responses, near and far sightedness);

(iii) perform experiments to determine the near point of each eye, and to observe changes in the eye during accommodation;

(iv) locate the blind spot using the cross and black circle diagram (8a);

*b) (i) perform a dissection of a sheep or cow eye to locate the parts of the eye and its associated structures;

(ii) demonstrate using a model the path of light rays in the human eye (6a, 8b);

c) examine illustrations of optical illusions;

d) (i) demonstrate sound wave phenomenon by striking a variety of tuning forks of varying frequency and observing their wave forms;

  (ii) test their ability to detect sounds of low and high frequency using an audio generator;

  (iii) perform experiments to investigate the effects of visual cues and body orientation on balance;

  (iv) examine a model of the human ear (6b, 6d, 8b);

*e) (i) map taste regions of the tongue (6c);

  (ii) close off the nose and compare the taste of similar samples of an onion and an apple (6c);

f) determine the density of touch receptors in different areas of the body using two point discrimination;

*g) (i) determine the reaction time for both hands;

  (ii) locate reflex areas of the body by gently tapping the knee and inside elbow with a rubber hammer;

h) complete a library research project on disorders of the eye and ear and possible treatments;

i) investigate the ability of the hand to estimate temperatures.

*See the subsection entitled "Student Activities" on page 10.

3. Applications

a) A knowledge of the structure and function of the eye is fundamental to the development of appropriate eye glasses.

b) The eye is a sensitive organ that must be protected from bright sunlight and flying objects.

c) Proper first-aid treatment of eye injuries resulting from an accident in the home, laboratory or at work must be immediate to minimize damage.

d) Knowledge of proper working or reading conditions with respect to lighting will help reduce eye strain.

e) Stereo equipment such as personal radios and amplifiers should be maintained at low volumes to prevent hearing loss particularly when used with headsets and earphones.

4. Societal Implications

a) Through the development of technical devices, people with visual and hearing impairments can be helped to lead happier lives.

b) Knowledge of safety procedures can reduce the incidence of sensory injuries.

c) Technological advances have increased the opportunities of coming into contact with super-stimuli which can cause sensory impairment.

d) A respect for an individual's personal space should be fostered particularly regarding noise pollution.

5. Evaluation of Student Achievement

At least 50 per cent of the term mark for this unit is to be based on students':

a) ability to demonstrate proper dissection techniques, and identify specific structures observed during the dissection;

b) ability to organize a personal visual chart;

c) formal laboratory reports.

6. Safety Considerations

a) Protective eyewear and gloves should be worn during dissections. All preserved specimens should be thoroughly washed in the tap water prior to use. The laboratory should be well ventilated during the dissection.

b) When simulating a state of temporary blindness, partners must remain in close proximity and warn the "blinded" student when approaching hazardous obstacles.

c) Students should be surveyed for food allergies prior to performing taste tests and all test materials and solutions should be handled in a hygienic manner.

d) Equilibrium experiments involving rapid spinning of the body require a large space free of desks to ensure students will not collide with anything should they lose their balance. Partners should be used to prevent falls. Students should remove eye glasses. Gym mats could be used to help prevent injuries.

e) Students wearing contact lenses should be aware of potential problems from preservative fumes.

7. Possible Extensions

Some students might:

a) perform light ray experiments to investigate using a variety of lenses to correct near and far-sightedness;

b) investigate a variety of eye glasses with different lenses, or to determine their effect on vision. Examples could include polarized, smoked glass, welder's eyewear, lenses of different colours (rose, blue, grey, yellow);

c) investigate the phenomena of positive and negative after-images that result from looking at an object intently for a period of time;

d) examine the variety of commercially available contact lenses, such as hard, soft and porous types and discuss the care and safety aspects of these lenses;

e) use an astigmatism chart to determine the presence or absence of this disorder;

f) do a library research project on current medical advances in the treatment of eye disorders (e.g., cornea transplants, the use of lasers in cataract treatment, eye banks).

8. Some Teaching Suggestions

a) Students should develop an awareness of their own visual capacities by doing a variety of experiments designed to develop a personal visual chart.

b) Models can be used to demonstrate the structure and function of the eye and the ear.

c) Guest speakers who have experienced sensory impairment may assist students in becoming more aware of difficulties associated with these impairments.

d) It should be stressed that people with problems in sight and hearing are able to adapt to their handicap and can be productive individuals.

Core Unit 4: Respiratory/Cardiovascular Systems Time: 14 h

The human body may survive for many days without food, a few days without water, but death ensues very quickly without oxygen and an efficient transport system.

The respiratory and cardiovascular systems are essential to good health. By understanding the structure, function and maintenance of the respiratory and cardiovascular systems and the influences of lifestyle on them, students may make decisions which can lead to a more healthy life.

Certain aspects of this unit may have been studied previously by students in the Health Education program. It is highly recommended that teachers of this course confer with those teaching Health Education prior to teaching this unit in order to clarify what each course will accomplish and to reduce or eliminate overlap in content.

This unit may be divided into topics such as the following:

- Respiratory system
- Cardiovascular system
- Breathing
- Chemical respiration

1. Objectives

Attitudes. Students will be encouraged to develop:

a) curiosity in investigating how their cardiovascular system functions (2a-2d);

b) a commitment to maintain healthy respiratory and cardiovascular systems (4b);

c) a respect for a clean air environment for non-smokers;

d) a commitment to assist individuals who are under respiratory or cardiovascular stress;

e) critical-mindedness in using scientific knowledge when examining their life style for strengths and weaknesses.

Skills. Students will have the opportunity to develop skill in:

a) manipulating a stethoscope and using it to listen to breathing sounds (2a);

b) measuring factors such as respiration values, blood pressure and heart rates (2b-2d);

c) recording and tabulating data on respiration values, heart rates, and blood pressure (2b-2d);

d) calculating total lung capacity, exhaling reserve volume, and vital capacity; (2b);

e) interpreting data from the effect of mild exercise on the respiration rate (2b, 2c);

f) following procedures during the dissection of a sheep or beef heart (2e);

g) making and testing hypotheses to account for observed differences in respiratory and cardiovascular profiles within the class (2a-2d).

Knowledge. Students will be expected to:

a) identify the components of air, including possible pollutants, and indicate the effect of changes in the levels of oxygen and carbon dioxide on the respiratory system;

b) describe the function and location of structures involved in breathing, for example, the nose, trachea, bronchus and alveolus (2a, 8f);

c) differentiate between the composition of inhaled and exhaled air (2a);

d) state the characteristics of a healthy respiratory system (2a, 2b);

e) explain how smoking effects the respiratory and cardiovascular systems (2g);

f) explain the role of air pressure changes within the chest cavity in controlling the mechanical process of breathing (8b);

g) recall that cellular respiration involves exchanging carbon dioxide and oxygen between cells as well as chemical reactions within cells;

h) be able to list the parts and function of a human heart (2e);

i) describe the route taken by blood in its circulation through the heart (2e);

j) identify the components of blood and state the function of each component (2f);

k) compare and contrast the respiratory systems of healthy and diseased individuals using X-rays or photographs (2g);

l) name at least two first aid techniques used in cases of emergencies involving the respiratory or cardiovascular systems and describe how each functions (8d);

m) describe the process of gas exchange in the blood.

2. Student Activities

Students are to:

*a) use a stethoscope to listen to breathing sounds made by the lungs and trachea while resting and following vigorous activity (6b);

*b) determine the respiration values (tidal volume, expiratory reserve volume, inspiratory reserve volume, vital capacity) using a spirometer while standing, seated and prone and propose hypotheses to account for observed differences between classmates (6b, 8c);

c) try to listen to the sounds made by the heart or blood at several points in the body such as the pulse points on the neck, inside of the elbow and the wrist, and compare the heart rate and sounds before and after mild physical activity (6b);

d) measure the blood pressure using a sphygmomanometer before and after mild physical activity, before and after drinking coffee, or cola, and then time the return to normal blood pressure (6b);

*e) perform a sheep or beef heart dissection and trace the flow of blood through the heart noting the location and construction of the chambers and valves of the heart (6b, 8f);

f) examine a commercially prepared blood smear slide for various types of blood cells;

g) examine a variety of X-rays or photographs of healthy and diseased lungs.

*See the subsection entitled "Student Activities" on page 10.

3. Applications

a) Exercise and diet have a profound effect on both the respiratory and cardiovascular systems.

b) Courses are taught by qualified instructors to demonstrate first-aid procedures for the cardiovascular and respiratory systems.

c) Blood pressure varies with a wide variety of activities and is one of the many indicators of an individual's present state of health.

d) Masks are necessary to work safely within certain environments (e.g., insulation installation).

4. Societal Implications

a) A variety of careers in the health sciences are available for students with interests in the respiratory/cardio-vascular systems.

b) Smoking, air pollution, chemicals and poor diet can cause deterioration of the respiratory/cardiovascular systems.

c) Students and adults may find that first aid and lifesaving techniques may have immediate applications during their life.

5. Evaluation of Student Achievement

At least 50 per cent of the term mark for this unit is to be based on students':

a) ability to interpret data from laboratory work;
b) records of laboratory work;
c) ability to identify the parts of the heart in a beef heart dissection.

6. Safety Considerations

a) Beef or sheep hearts should be washed thoroughly in tap water before dissection. Students should use protective eyewear and gloves during dissections. The laboratory should be well ventilated during the dissection.

b) Students with medical problems related to the respiratory/cardiovascular systems should be excused from any activities that would cause unacceptable stress.

c) Equipment such as stethoscopes and spirometers should be sterilized prior to student use.

7. Possible Extensions

Some students might:

a) investigate and report on statistics on heart or lung diseases involving smoking, diets, allergies and stress;

b) prepare a dried pig lung;

c) prepare a report on artificial hearts and organ transplants.

d) investigate the effect of carbon dioxide concentration on breathing rates.

8. Some Teaching Suggestions

a) A stethoscope can be used to examine the sounds made by each of the parts of the respiratory system.

b) A model of the chest cavity made from a bell jar and balloons can be used to illustrate the breathing mechanisms.

c) The preparation of a student self profile on various aspects of the respiratory and cardiovascular systems can be done in tabular form. Comparisons can be made with classmates and class averages can be taken.

d) First aid techniques should be demonstrated by individuals trained to teach first aid procedures.

e) A member of the local police department can be invited to the class to demonstrate the function of a blood alcohol measuring machine.

f) A pig pluck can be used to demonstrate the interrelationships between the respiratory and cardiovascular systems.

g) Some sheep hearts and beef hearts have fat deposits on the heart and arteries. Discussion and illustrations of the effects of diets on the heart and arteries should accompany the dissection activity. Teachers should be aware of the controversial nature of connections between diet and heart disease.

Core Unit 5: Genetics and Reproduction Time: 14 h

Students are regularly confronted with the issues surrounding sexuality, fertilization prevention, sexually transmitted diseases and family planning. One role of this course is to provide students with up to date scientifically determined information and explanations behind these issues. Many recent discoveries in the field of molecular genetics are particularily relevant to these issues.

It is highly recommended that teachers of this course confer with those teaching Family Studies and Health Education prior to teaching this unit in order to clarify what each course will accomplish and to reduce or eliminate overlap in content. It is especially important that the teaching of Applied Biology is not seen to be in conflict with the human dimensions of values and morals regarding sexuality and parenting discussed in the Family Studies and Health Education programs.

This unit may be divided into topics such as the following:
- DNA and chromosome structure
- Body cell and sex cell formation
- Mendelian genetics
- Male reproductive system
- Female reproductive system
- The menstrual cycle, pregnancy and birth
- Sexually transmitted diseases
- Fertilization prevention

1. Objectives

Attitudes. Students will be encouraged to develop:

a) an appreciation for the quantity of information coded within the DNA molecule;

b) an appreciation of the diversity of human characteristics and the role of genes in behavioural and personality traits (2d);

c) a concern for the proliferation of mutagenic agents (3b);

d) an appreciation that the union of two small sex cells produces a unique and very complex individual;

e) objectivity in considering modern medical advances and research into in-vitro fertilization (3a, 4c, 4e, 8a);

Skills. Students will have the opportunity to develop skill in:

a) observing sperm and egg cells under the microscope (2a);

b) using Punnett squares to carry out a pedigree analysis (2e);

c) predicting the genotypes and phenotypes of offspring given the genotypes and/or phenotypes of the parents (2e);

d) observing genetically determined human characteristics (2d);

e) recording and organizing data from the human characteristics laboratory in tabular form (2d).

Knowledge. Students will be expected to:

a) state that DNA is the basic hereditary chemical of life and that it acts by directing the assembly of amino acids and protein in the cell;

b) explain the meaning of the terms: gene, chromosome, body cell, sex cell (sperm and egg), phenotype, genotype, homozygous, heterozygous, mutation, mutagenic agent, zygote, embryo, fetus;

c) state that the genetic code is the basis of inheritance;

e) demonstrate examples of inheritance by drawing Punnett squares using specific human characteristics (2e);

f) explain the role of chromosomes in sex determination, fraternal and identical twins, and genetic disorders (e.g., Down's syndrome, Turner's syndrome, hemophilia);

g) describe the structure and function of the parts of the male and female reproductive systems;

h) list the organs of origin, and the functions of the following hormones: testosterone, follicle stimulating hormone, luteinizing hormone, progesterone, estrogen;

i) describe the type of information provided by technologies of fetal analysis such as ultrasound, or amniocentesis;

j) explain how specific environmental agents may affect a pregnant woman and her fetus (e.g., tobacco, alcohol, cannibis);

k) outline the biological basis of sexually transmitted diseases such as AIDS, gonorrhea, syphilis, or vaginitis (8a, 8c);

l) describe several natural and artificial methods of fertilization prevention and explain how each functions (8a, 8c).

2. Student Activities

Students are to:

*a) examine prepared slides of human or rat testis for size, shape and numbers of sperm and examine prepared slides of human or rat ovary for the follicles and oocytes;

b) observe a dissection of a preserved pregnant vertebrate (6);

c) observe the laws of probability by flipping a coin many times and relating the results to a genetic cross;

*d) observe and tabulate human traits that are genetically determined (e.g., blood type, Rh factor, hairline, freckles, finger hair, ear lobes and rim, colour blindness, folded hands, tongue roll);

*e) draw and use Punnett squares to explain patterns of single gene inheritance of various human characteristics;

f) draw a pedigree of a family tracing inheritance of easily determined phenotypes (e.g., ability to roll the tongue);

g) examine photographs of a human fetus at various stages of development.

*See the subsection entitled "Student Activities" on page 10.

3. Applications

a) New advances in genetic engineering may result in the production of drugs to control human disease.

b) Agents in the environment such as alcohol, tobacco, medical and other drugs may cause mutations that result in genetic disorders.

c) Genetic counselling which is available to prospective parents may improve the prospects of producing healthy offspring.

4. Societal Implications

a) Human population is increasing in some parts of the world to the point where adequate food supplies are not locally available.

b) Low birth rates can change the age distribution in a population.

c) Boundaries may have to be set limiting present and future experiments in genetics.

d) The responsibility for caring for individuals with genetic disorders is shared by the community as a whole.

e) Screening programs are available for the detection of genetically determined disorders.

5. Evaluation of Student Achievement

At least 50 per cent of the term mark for this unit is to be based on students':

a) facility with the microscope in observing sperm and egg cells;

b) observations and records of human characteristics;

c) ability to use Punnett squares to do an analysis of the inheritance of human characteristics.

6. Safety Considerations

Gloves should be worn when handling preserved specimens.

7. Possible Extensions

Some students might:

a) observe the eggs and sperm of snails for early stages of cleavage under the microscope;

b) prepare and examine slides of frog testes for sperm and frog ovaries for oocytes;

c) perform test crosses using fruit flies;

d) obtain a photograph of a cell nucleus during mitosis, and do a karyotype analysis;

d) construct a model of a DNA molecule;

e) dissect fresh smelt minnows or other small fish at spawning time to acquire sperm and eggs and attempt to observe fertilization taking place on a microscope slide;

f) review and present for discussion data on common conditions such as heart disease, diabetes or cancer that are caused by many factors;

g) conduct a library research project concerning a topic such as the experiments of Watson and Crick, birthing techniques, child birth defects, mutagenic agents, or the role of Canadian scientists in genetic research.

8. Some Teaching Suggestions

a) This unit should focus on the biological principles and concepts necessary for an understanding of genetics and reproduction. The nature of this unit is such that many sensitive issues may be raised during class discussions. Teachers should treat these issues with sensitivity. Appropriate strategies for dealing with sensitive issues are outlined in Part 1, section 13, of this science guideline. Also it is most important that teachers of Health and Family Studies be involved with the planning for this unit in order to present students with a balanced view of the scientific, social and health considerations inherent in the study of human reproduction and genetics.

b) Many excellent films are available on topics related to genetics and reproduction.

c) Guest speakers from outside agencies such as health units, and nursing schools, should be encouraged.

d) There are many genetics centres in Ontario where resource materials are available for the use of teachers.

Core Unit 6: Waste Management Time: 14 h

A study of human biology is not complete without a consideration of the impact of humans on their environment. This impact results from the use of natural resources for food and manufactured materials and the subsequent release of waste into the environment. Waste in the environment may result in serious health and ecological problems. The management of the waste that results from human activities is important to prevent these problems. Students should appreciate the need to limit waste products and the need to develop strategies to control the waste which is produced.

This unit may be divided into topics such as the following:
- Suspended matter in water
- Chemical pollution
- Water purification
- Air pollution
- Garbage
- Waste treatment

1. Objectives

Attitudes. Students will be encouraged to develop:

a) objectivity in interpreting the results of the qualitative analysis of water and air samples (2b);

b) a concern about safety when handling water samples of unknown purity (2a, 2b);

c) an appreciation of the need to solve the acid rain problem (2d, 2e, 2g);

d) objectivity in evaluating responsibility for environmental pollution;

e) a commitment to reduce the quantity of garbage generated at home (2h);

f) curiosity in evaluating the waste management controls in the community;

g) an appreciation that human and industrial waste can cause ill health (2i);

h) objectivity when evaluating a mass media coverage of waste management issue (2j).

Skills. Students will have the opportunity to develop skill in:

a) manipulating light and/or stereo microscopes when observing biological indicators of pollution (2a);

b) interpreting data to evaluate air and water quality (2a, 2b, 2f);

c) developing a classification scheme for water and air pollutants;

d) determining the acidity of acid in samples of rain, water or snow (2g);

e) organizing the collection of data in experiments;

f) calculating the percentage composition of home refuse, for example, the percentage of paper, styrofoam, plastic, metal and glass (2h).

Knowledge. Students will be expected to:

a) list types of organisms found in water of varying quality (2a);

b) list techniques used to purify and sterilize water (2c);

c) outline the significance of water and air pollution tests;

d) explain using word equations how sulphur combustion results in the production of acid rain (2d);

e) state the effect of acid rain on selected living organisms and on some common materials (2e);

f) define the term micrometre (um) (2f);

g) distinguish between the terms non-biodegradable and biodegradable (2h);

h) explain the function of the major components of a sewage treatment plant and a household septic system (2i).

2. Student Activities

Students are to:

*a) use a microscope to observe suspended matter and organisms in water samples obtained from a variety of sources (6a, 6b, 8e);

*b) analyse collected water samples or teacher-prepared simulations for the presence of oxygen and pollutants, for example, lead, phosphate, and nitrate (6a);

c) perform experiments to demonstrate purification techniques (e.g., filtration, floculation);

d) perform an experiment which will demonstrate the production of acid rain from the results of sulphur combustion (6c);

e) perform experiments which will demonstrate the corrosive qualities of mild acid on plants, metals and carbonates (6d);

f) collect particulate matter from the air for at least 24 h on a vaseline covered slide and attempt to identify and classify particles by type, size and possible source (6b);

*g) use indicators to determine the acidity of rain (snow);

*h) calculate the percentage composition of garbage generated in the home and/or classroom for a week 6e, 8h);

i) evaluate and report on the effectiveness of the waste management technology used in the community to treat human waste and dispose of refuse (8g);

j) conduct a case study to determine the best location for a proposed waste disposal site.

*See the subsection entitled "Student Activities" on page 10.

3. Applications

a) The segregation of home garbage into biodegradable, glass, metal, paper and plastic makes the recycling of wastes possible.

b) Knowledge of pollution standards will enable students to identify pollution that could cause health problems.

c) A reduction in acid rain would reduce costs to replace damaged materials and would reduce the trend of increasing acidification of lakes which threatens the survival of many aquatic species.

d) A lifestyle can be adopted which minimizes negative impacts on the ecosystem (e.g., conservation practices, clean-up campaigns, recycling).

4. Societal Implications

a) Improperly treated human excrement and other wastes, for example, nuclear, animal, and industrial, reduces the water quality in many Ontario communities.

b) Much progress in reducing effluents has occurred over the last decade but society should strive for greater advances as technology becomes available.

c) Air pollution as a by-product of human activity poses a serious threat to the forestry and tourist industries.

d) Pollution control measures have been developed to reduce or eliminate wastes generated by human activities.

e) Overpackaging of products with non-biodegradable substances creates serious disposal problems to the community.

5. Evaluation of Student Achievement

At least 50 per cent of the term mark for this unit is to be based on students':

a) analyses of the components of polluted water;

b) calculations of the percentage composition of home garbage;

c) ability to use the microscope and report accurately what is observed.

6. Safety Considerations

a) Caution must be exercised in handling any water suspected of being polluted.

b) After handling chemicals and pollutants, students should wash their hands, all desk surfaces and slides after use.

c) Sulphur should be combusted in a fumehood.

d) Care should be exercised in handling acids.

e) Students should wear masks and rubber gloves when handling garbage generated in the home or classroom.

7. Possible Extensions

Some students might:

a) apply the analytical techniques learned in class to a stream or lake study in the area;

b) study the effect of an acid atmosphere on plant structure and growth;

c) analyse the paper waste in the school and design and implement a program to recycle it;

d) keep a record of pollution control readings for a period of time and relate these to geographical and meteorological factors;

e) study lake acidity data and predict the impact that acid rain could have in the next decade and beyond;

f) shred, de-ink, and make new paper from old newspapers.

3. Some Teaching Suggestions

a) This unit should focus on the theme of waste management in the home and the community. Students should be constantly aware of this theme and should consider the real costs to the taxpayer for all aspects of waste management.

b) The topics chosen for this unit will to a large extent depend on the time of year, the geography of the region and the local technologies used in waste management. The student activities are designed to allow for this flexibility.

c) A visit to a local sewage treatment plant or solid waste disposal site should be considered.

d) A nutrient rich aquarium seeded with algae can be started and observed and tested over a period of a few weeks.

e) Since some of the commercially available invertebrate keys are too difficult for many students a simple list of indicator organisms and pictures should be provided.

f) The reduction of wastes should be related to the wise use of energy.

g) Teachers should be cautious not to imply that technology alone will solve all pollution problems. Cost factors and political decisions might also be discussed.

h) Students can be encouraged to analyse the garbage generated in either a home or classroom by providing rubber gloves and masks and by not handling food wastes.

Optional Unit 1: Home Gardening

Time: 12 h

As an alternative to purchasing food for the body's needs, home gardening can help to supplement a family's dietary needs. Knowledge of soil conditions and plant requirements are fundamental to planning and maintaining a garden. The intent of this unit is to provide the student with a basic understanding of the fundamental principles of gardening and some experience in selecting and handling plant materials.

This unit may be divided into topics such as the following:

- Soil nutrients
- Properties of soil
- Soil organisms
- Planning a garden
- Organic gardening
- Chemical control

1. Objectives

Attitudes. Students will be encouraged to develop:

a) a concern for the health of humans who may consume chemically treated foods (2i, 3b);

b) open-mindedness towards new agricultural technologies ([illegible]

c) objectivity when comparing organic versus traditi [illegible] rdening techniques (2f, 3b);

d) an appreciation for the fundamental role of plants in the production of food and oxygen;

e) a questioning attitude towards the indiscriminate use of pesticides and herbicides (2i, 3b);

f) a commitment to the safe handling, disposal and storage of pesticides, herbicides and fungicides (2i, 3d).

Skills. Students will have the opportunity to develop skill in:

a) analysing the nutrient content and pH of soil samples (2a);

b) calculating the percentage of water in soil samples (2b);

c) manipulating a microscope when determining nematode density (2c);

d) organizing information when planning a garden plot (2e);

e) graphing data obtained from the onion-germination suppression experiment (2f);

f) following procedures for growing vegetables hydroponically and/or propagating house plants (2g, 2h);

g) recording data from the labels on pesticide, herbicide and fungicide containers (2i).

Knowledge. Students will be expected to:

a) state the role in plant growth of nitrogen, phosphorus, potassium, and pH (2a);

b) explain the symptoms of some common nutient deficiency diseases in plants (2a);

c) list and state the importance of some physical properties of soil (2b);

d) describe the role played in soil formation by soil organisms such as fungi, nematodes and earthworms (2c);

e) state the factors which must be considered for the successful planting and harvesting of a garden (2d, 2e);

f) compare and contrast techniques used in organic gardening with those of more traditional chemical gardening practices (2f);

g) discuss the advantages and disadvantages of hydroponic gardening (2g);

h) list common propagation techniques used in growing house plants (2h);

i) differentiate between pesticides, herbicides, and fungicides (2i).

2. Student Activities

Students are to:

*a) analyse soil samples for the presence of nitrogen, phosphorus and potassium and determine the pH (6a, 8b);

*b) determine and calculate the water-holding capacity of soil samples (6a, 8b);

c) perform an experiment which will determine the population density of soil nematodes (6a);

d) investigate the conditions which are required to grow some vegetables and/or herbs commonly found in a small garden;

e) draw a plan for a garden which would include various plants showing the location which would maximize the yield;

f) perform an experiment which would test the hypothesis that onion contains a substance which suppresses the germination of other types of seeds (8f);

g) grow a vegetable hydroponically (6d);

*h) propagate plants using various techniques such as cuttings, grafting and germinating seeds (6c, 6d, 8g);

*i) examine the information contained on the labels of a variety of garden pesticides, herbicides and fungicides regarding use, safety in storage, disposal of empty containers, and toxicity (6b).

*See the subsection entitled "Student Activities" on page 10.

3. Applications

a) Proper cultivation methods can maximize food production at home and reduce home food costs.

b) Organic gardening techniques can help to reduce organic pesticide residues in food.

c) Propagation techniques allow for an inexpensive way of increasing the number of house plants.

d) The safe handling of pesticides and herbicides may prevent an accident from long term exposure to toxins.

e) The propagation and maintenance of plants may provide many enjoyable hours of leisure activity for some people.

4. Societal Implications

a) There are many careers in plant related fields such as landscape gardener, greenhouse operator, and florist.

b) The decrease in soil quality and the quantity of arable land could result in serious food supply problems in the future.

c) New technologies such as the use of solar energy and hydroponics could help to decrease food shortages.

d) Plants help to increase the quality of life [illegible] urban centres.

e) Indiscriminate use of non-biodegradable pesticides and herbicides is a health and environmental threat.

f) The development of a home garden is one way in which a family may lower their food costs.

5. Evaluation of Student Achievement

At least 50 per cent of the term mark for this unit is to be based on students':

a) calculations of the water holding capacities of soils;

b) laboratory reports;

c) ability to care for experimental plants.

6. Some Safety Considerations

a) Hands should be washed after handling soil samples.

b) Pesticide and herbicide labels should be supplied by the teacher.

c) Sterile soil should be used wherever possible.

d) The class should be surveyed for allergies prior to handling plant materials.

7. Possible Extensions

Some students might:

a) examine microscope slides of herbaceous and woody stems to study plant growth;

b) visit or invite to the class a plant specialist such as a florist, landscape architect, food crop specialist, or consulting agronomist to discuss careers related to the plant sciences.

c) germinate the seeds of Ontario trees and arrange for their planting;

d) germinate and plant flowers for the school's garden;

e) calculate the amount of money which could be saved by growing and preserving garden plants;

f) investigate maintenance techniques such as pruning for winter protection;

g) investigate companion gardening.

8. Some Teaching Suggestions

a) Teachers who choose this unit should carefully consider the time of year when it is to be taught in order to maximize student activities.

b) Soil samples obtained from the home/farm can be analysed and compared to add more interest to soil testing.

c) Students should be aware of the variety of jobs in the food producing and processing industry.

d) Many students increase their sense of responsibility if they have their own plants to care for rather than a class set of plants. If the classroom facilities restrict space for plant growth experiments, students may perform the experiments at home, bringing the plants to class on completion of the experiment.

e) Plants which are used as decoration in the classroom can be used as a source of plant materials.

f) Research has shown that onion contains a substance called allacin which suppresses seed germination of other plant species. Onion can be macerated in the blender and varying amounts placed in petri dishes with carrot seeds. Interesting results can be obtained by varying onion type, seed type, and quantity. This activity provides an opportunity to discuss organic gardening.

g) The use of plant growth florescent tubes over growing plants makes many of this unit's activities possible in winter.

Optional Unit 2: Skin

Time: 12 h

The human skin has a wide variety of functions and, as the largest organ in the body, is subjected to a number of constantly changing environmental conditions. This unit examines the structure of skin and its role as a sensing organ, as an organ of excretion and its role in sustaining a homeostatic internal body condition. Skin care is vital to maintaining a healthy body. A variety of methods for keeping the skin and hair healthy are examined.

This unit may be divided into topics such as the following:

- Skin structure and function
- Skin as a sense organ
- Skin and hair care
- Scarring and wrinkling of skin
- Skin and hair disorders
- Skin allergies
- Effects of radiation

1. Objectives

Attitudes. Students will be encouraged to develop:

a) a questioning attitude towards the variety of skin and hair care products as described in the media (3a);

b) curiosity in discovering that there are both similarities and differences between the skin structures and patterns of various individuals (2a, 2b, 2d);

c) an empathy for individuals who have skin disorders.

Skills. Students will have the opportunity to develop skill in:

a) recording and preparing data on a skin profile (2a, 2c, 2d);
b) using magnifiers or binocular microscopes to examine skin surfaces (2a);
c) classifying and locating the skin nerve senses, for example, touch, pain, hot and cold (2c);
d) designing an experiment dealing with sun screens, hair care or cosmetics (2f);
e) interpreting the results obtained by mapping sweat pore locations and comparing these results to the observations of a skin profile (2d);
f) observing and classifying finger prints from several individuals (2b).

Knowledge. Students will be expected to:

a) describe the structure of skin (2a, 2c, 2d);
b) describe typical finger print patterns (2b);
c) state the functions of skin;
d) outline proper procedures for healthy skin and hair care;
e) state the characteristics of hair and skin care products and the proper use of these products (2f, 2g);
f) state the causes and effects of scarring and wrinkling;
g) explain how to take care of common skin disorders;
h) outline the effects of solar radiation on skin and hair;
i) describe the characteristics of burns, allergies, and acne;
j) describe first aid procedures for skin problems (e.g., burns, acne);

k) describe the symptoms of skin cancer;

l) state the need for sun screens to protect against solar radiation (2f);

m) know the active ingredients and rating scales of sun screens products (2f).

2. Student Activities

Students are to:

*a) using a magnifying glass or binocular microscope examine the surface structure of the skin including the structure of scars, finger nails, cuticle, hair root, freckle or mole and compare the surface of the palm to the back of the hand in relation to ridges and furrows, patterns, skin attachment, sweat gland locations, thickness, hair presence and structure;

*b) using an ink pad to prepare fingerprints of each finger classify finger prints to one of the ten basic patterns and compare the pattern of each print to that of other fingers on the same individual and to a laboratory partner;

*c) prepare a skin pattern map for nerve sensors (touch, pain, hot, cold) for the forearm and the calf of the leg;

*d) prepare a map of sweat pores on different skin surfaces using starch and iodine as an indicator (6a);

e) compare the effect of immersing a finger of each hand in water at different temperatures and subsequently placing the fingers in water at the same temperature;

*f) design, conduct and report on an experiment or do a library research project on;

the protective nature of sun screens, tanning oils and instant tanning products;

OR

the effect of bleaches, rinses, dyes, hair-perming solutions, and hair removers on hair;

OR

the effect of various types of hair shampoo and conditioners on hair maintenance;

OR

the effect of a wide variety of cosmetics on skin health (6b, 8a);

g) compare the pore openings on different palms following vigorous activity when one palm has been treated with an anti-perspirant.

*See the subsection entitled "Student Activities" on page 10.

3. Applications

a) A critical examination of the advertising statements in the media should allow students to select appropriate personal skin and hair care products.

b) Sun tanning oils and sun screens contain ingredients that protect the skin with varying degrees from harmful radiation.

c) Comparing finger print patterns may be used for purposes of individual identification.

4. Societal Implications

a) Skin cancer may be a direct result of solar radiation. By understanding the nature and sensitivity of their own skin to such radiation, and the means of protection, students may reduce the incidence of skin cancer or severe burns.

b) The early diagnosis of skin problems will allow for treatment, and thus may prevent infection, loss of work time or addition to the costs of hospital care.

c) A wide variety of careers are available to students involving skin and hair care (e.g., cosmetologist, dermotologist).

5. Evaluation of Student Achievement

At least 50 per cent of the term mark for this unit is to be based on students':

a) laboratory reports;

b) observations and classifications of finger prints;

c) preparation of a skin pattern maps for nerve sensors.

6. Safety Considerations

a) A dilute solution of iodine should be used when counting and locating sweat pores and washing facilities should be available.

b) Students should be surveyed for any allergies to the products used in this unit prior to performing any of the specific tests.

7. Possible Extensions

Some students might:

a) study the effects of a variety of rinses, dyes, shampoos, conditioners, on a small lock of hair;

b) investigate the effect of a variety of soaps for emulsifying liquid fat (oil);

c) prepare a report on the current first aid practices for skin problems and burns which are accepted by St. John's Ambulance and/or the Red Cross.

8. Some Teaching Suggestions

a) Teachers may wish to invite a professional hair dresser, cosmetician, or a dermatologist into the class to discuss practical hair and skin care.

b) This is an excellent unit in which to use tables and charts to organize data on the structure of skin.

c) First aid instruction should be demonstrated by individuals trained to teach first aid procedures. Presentations about first ai[illegible]e skin can be made by students who have complete[illegible] appropriate courses.

d) A drug store survey of the wide variety of over-the-counter drugs an[illegible] care products that are available may be practical in certa[illegible]

e) Hair car[illegible]ple of cat fur.

Optional Unit 3: Bones and Muscles - Body Support Time: 12 h

The skeleton provides the framework for the body. The protection of vital organs and the production of blood cells are also important roles of the skeletal system.

Muscles are attached to the skeleton and in order to initiate body movements they undergo contraction to perform flexion actions, and relaxation to perform extension actions.

The interrelationship between muscles and bones in performing their respective roles is important for an understanding of the body support system.

Since the bones and mysces are integral to providing flexible and controlled movements, it is essential that students realize the limitations of the skeletal and muscular systems, and understand how a good diet and proper exercise can lead to general overall health of the body.

This unit may be divided into topics such as the following:

- Bone
- Cartilage
- Joints
- Muscle
- Tendons and ligaments
- Disorders

1. Objectives

Attitudes. Students will be encouraged to develop:

a) an appreciation for the interrelationship between bone and muscle in their role of supporting body tissues (2c);

b) curiosity about the structure of bones and muscles (2a, 2c, 2f);

c) an appreciation for the relationship between the structure of the skeletal system and its various functions (2c);

d) a commitment to use appropriate attire and safety equipment to protect the bones and muscles (2j);

e) an appreciation of the need for proper warm up and cool down activities before and after periods of strenuous exercise (2j).

Skills. Students will have the opportunity to develop skill in:

a) observing fresh or preserved specimens of long bones and identifying their major structures (2a);

b) interpreting results of chemical tests to determine bone properties (2b);

c) classifying a selection of bones of a vertebrate skeleton according to the categories flat, long and irregular (2c);

d) identifying the structures of the support systems and describing their functions (2c);

e) labelling diagrams of a synovial joint, for example, knee, or elbow (2d, 2e);

f) observing X-rays or photographs of the human skeleton noting the relationship of structures and possible disorders (2h);

g) measuring fatigue time in the investigation of muscle activity (2i);

h) measuring reaction time as affected by exercise and muscle fatigue (2i);

i) dissecting striated muscle and associated structures (2f).

Knowledge. Students will be expected to:

a) state basic functions of an internal skeletal framework;

b) list the basic structures of a long bone, for example, compact and spongy bone, bone marrow, and articular and epiphyseal cartilage and state a function of each (2a);

c) describe the chemical composition of bone tissue and relate this to diet and to its support function (2b);

d) compare cartilage and bone tissue with respect to composition, physical properties, and function in the body (2a, 2b);

e) describe how the shape and structure of a bone corresponds to its location and function in the body (2c);

f) describe several skeletal adaptations that allow vertebrates both bipeds and quadripeds to perform specific activities, for example, flight in birds, and movement of the thoroughbred race horse (2c);

g) describe the structure and function of a synovial (hinge-like) joint, using the knee, or the elbow as an example (2d);

h) compare the location, structure, and function of tendons and ligaments (2e);

i) identify the structures of the human arm and pectoral girdle to demonstrate the antagonistic pairing of the biceps-triceps (2e)

j) explain antagonistic pairing as it relates to muscle operation (2e);

k) describe the three types of muscles, their major properties, characteristics, and location;

l) describe how body movement is related to the principle of levers (2e);

m) explain the significance of exercise for muscle operation, for example, the distinction between isometric and isotonic exercises and explain the term muscle fatigue and how to deal with it (2i);

n) distinguish between the terms hypertrophy and atrophy as related to muscle tissue under condition of stress (strenuous exercise) and/or inactivity such as results from being in a cast (2i);

o) describe first aid treatments used for various injuries of the skeletal system (2j).

2. Student Activities

Students are to:

*a) examine a fresh specimen of a long bone, whole and in longitudinal cross-section, identifying and stating the function of compact and spongy bone, marrow, and cartilage (6a, 8a);

*b) examine bone appearance and rigidity before and after placing a bone in a dilute solution of hydrochloric acid for several days (6b);

*c) examine a variety of vertebrate skeletons, for example, a bird, mammal, or human, noting similarities and differences, adaptations for specific functions, and differences between sexes (8b);

*d) use a fresh specimen or a model of a knee joint to illustrate general joint structures;

e) demonstrate antagonistic pairing in the operation of the biceps and triceps by raising and lowering an object placed in the hand and label the structures on a diagram;

*f) examine fresh stewing beef by teasing apart fibres and connective tissue using dissecting needles;

g) use a fresh turkey or chicken appendage to demonstrate tendon operation in the limb;

*h) observe X-rays or photographs of the human skeleton noting the relationship of the various structures including the major joint types and also noting possible disorders indicated by surgical treatments such as metal pins, staples, and cartilage replacement;

*i) investigate muscle fatigue and reaction time during a repeated activity such as lifting an object using an extended straight arm (8e);

*j) complete a library-research project on the types of bone and muscle injuries associated with sports and their possible first aid treatments such as sprained ankles, cramps, tennis elbow, torn ligaments, or jogger's knee;

or

complete a library-research project describing a common disorder of bones, muscles or joints, for example, osteoporosis, osteomyelitis, calcification, bursitis, sprains, dislocations, arthritis, gout, muscular dystrophy or poliomyelitis.

*See the subsection entitled "Student Activities" on page 10.

3. Applications

a) The diet must include a source of appropriate minerals to ensure proper bone development particularly during the formative or growth years.

b) The overall body plan does affect body capabilities and may limit body movement in specific exercises. This concept may help students select sporting events in which they may have a greater opportunity at excelling.

c) Selection of appropriate exercise programmes to achieve specific goals such as endurance or strength depending on specific needs of the individual, is made easier with an understanding of the body support system.

d) Proper warm-up and cool-down exercises should reduce the frequency of injuries to muscles and associated support structures.

e) Exercise is a major constituent in the maintenance of good health in body systems.

f) Selection of correct personal apparel appropriate to an activity is greatly assisted by a knowledge of the body's support system.

g) Knowledge of proper first-aid treatment may reduce the likelihood of severe body injury.

4. Societal Implications

a) The emphasis on physical fitness and resulting good skeletal and cardiac muscle tone, produces a healthier and more productive population.

b) Many careers involve the muscle and skeletal systems, for example, chiropractor, fitness instructors, and trainers for athletes.

5. Evaluation of Student Achievement

At least 50 percent of the term mark for this unit is to be based on students':

a) experimental data and formal laboratory reports;

b) ability to demonstrate proper dissecting techniques;

c) library research skills in describing the treatment of bone and muscle disorders.

6. Safety Considerations

a) Gloves and protective eyewear should be worn during a dissection. Specimens should be washed in tap water prior to use.

b) Caution must be exercised when handling acid.

7. Possible Extensions

Some students might:

a) investigate the mineral composition of bone using dilute nitric acid to dissolve crushed bone tissue and subsequently performing appropriate chemical or flame tests;

b) compare the structure of a skeleton and a bridge in terms of using girdles and arches for support;

c) explain the significance of limb-position in various classes of vertebrates such as fish, amphibians and mammals;

d) investigate the significance and types of levers in the body;

e) prepare and examine microscope slides of striated, smooth and cardiac muscle tissue;

f) investigate different types of exercise, such as isometric, isotonic, endurance, and strength, and indicate the resultant outcome.

8. Some Teaching Suggestions

a) The memorization of bone nomenclature should be kept to a minimum.

b) The interrelationships of muscles and bones and their organization to perform a particular function is an important concept and should be emphasized.

c) Guest speakers such as a representative from a sport clinic, a team physician, a physiotherapist or chiropractor may add interest to the unit.

d) Students should be encouraged to seek medical treatment when they experience an injury to the skeletal or muscle system.

e) The importance of exercise in the development and maintenance of a healthy and fit body should be stressed particularly in the aspect that a fit body usually is less prone to injuries which result from activity.

f) An individual with first aid training should be invited to demonstrate first-aid skills.

Optional Unit 4: White Rat Dissection

Time: 6 h

This unit is intended to complement the units in this course dealing with vertebrate systems. By integrating this unit with the others the student dissections of the rat will be more relevant to the course. During the dissection process students will have the opportunity to further develop their laboratory observing skills and to assimilate previous knowledge of each system studied in an attempt to interrelate them. The knowledge objectives will need to be modified if a mammal other than the rat is chosen for the dissection.

This unit may be divided into topics such as the following:

- External features and integuments
- Sensory system
- Digestive system
- Excretory system
- Respiratory system
- Circulatory and lymphatic systems
- Reproductive system

1. Objectives

Attitudes. Students will be encouraged to develop:

a) a respect for the complex organization and interdependence in the organ systems in all living things (2a);

b) a cooperative attitude when working with a laboratory partner during the dissection (2a);

d) a questioning attitude towards anatomical study (2a);

e) curiosity in learning about the internal and external body mechanisms (2a).

Skills. Students will have the opportunity to develop skill in:

a) manipulating dissecting instruments precisely and accurately (2a);

b) maintaining dissecting instruments in good working order (2a);

c) storing dissecting equipment and specimens in a clean organized manner (2a);

d) following laboratory instructions in proper sequence (2a);

e) identifying specific structures and observing their orientation and relationship to associated structures;

f) inferring the interdependence of systems based upon their organization in the body as a whole (2a);

g) sketching and labelling diagrams of each system as observed during the dissection (2b);

i) recording observations of each system in an organized and precise manner.

Knowledge. Students will be expected to:

a) define basic anatomical terms used in locating body structures during dissection, for example, dorsal, ventral, medial, anterior (frontal), posterior (caudal), superior, and inferior (2a);

b) identify the major components of the external features, for example, hair, teats, lips, urogenital and anal openings, tail, claws and scrotum in male specimens (2a);

c) (i) identify structures associated with the sensory system, for example, pinna, whiskers, external nostrils, eyes, upper and lower eyelids, and nictitating membrane (2a);

(ii) describe structural adaptations of sensory structures to assist in receiving stimuli, for example, short flexible pinna supported at its base by cartilage to rotate in the direction of a sound and funnel the sound waves toward the ear drum (2a);

d) describe the pattern of hair distribution on the body and contrast the reptile-like scales of the skin on the tail to human skin (2a);

e) compare foot structure of the rat to other quadripeds and to the hand and foot of the human noting special human adaptations for flexibility and support, for example, an opposable thumb, and foot arches (2a);

f) identify the major teeth types and describe how structure, shape and position on the jaw are related to their function in eating (2a);

g) compare the shape, texture and point of attachment of the rat's tongue to the corresponding features of the human tongue;

h) identify major structures in the head, neck and thoracic region associated with digestion, breathing and circulation, for example, salivary glands, larynx, epiglottis, trachea, thyroid glands, jugular veins and carotid arteries (2a);

i) identify and state the function of the capillary network and connective tissue (2a);

j) describe the distribution of fat and the blood vessel network associated with the mesentery supporting the small intestines (2a);

k) identify the orientation of muscle fibres in the thoracic and abdominal regions (2a);

l) (i) compare the internal stomach structure of the rat to that of the human stomach and outline the function of the rugae and mucus secretions (2a);

  (ii) describe the significance of the length of the digestive tract (2a);

  (iii) identify and describe the function of the major structures of the digestive system;

m) identify major structures of the excretory system and recall their close proximity to the reproductive structures (2a);

n) (i) identify major structures of the respiratory system;

  (ii) describe the structure of the trachea and its orientation to the esophagus during breathing and swallowing (2a);

o) (i) identify the four chambers of the heart and associated valves and blood vessels;

  (ii) relate heart wall thickness to function (2a);

p) identify the major reproductive structures of both sexes (2a);

q)) identify the major blood vessels in the rat, for example, aorta, carotid, vena cava, renal, hepatic, femoral, pulmonary, and jugular (2a);

r) (i) identify the locations of the lymph glands (nodes) and spleen (2a);

  (ii) apply the principle of muscle operation to explain the movement of lymph through the body (2a).

2. Student Activities

Students are to:

*a) perform a basic dissection of a white rat locating the major structures of the systems which were studied and noting the interrelationships of the various systems;

*b) sketch and label simple diagrams to locate the structures of each system;

c) prepare a colour coded diagram indicating each system as it is dissected.

*See the subsection entitled "Student Activities" on page 10.

3. Applications

a) Basic anatomical knowledge should help students to understand medical explanations given by a health professional.

b) Injury in one body location may lead to pain in another region. Knowledge of the interrelationship of body re[illegible] may help students understand body injuries.

4. Societal Implications

a) A knowledge of anatomy is essential in many careers, for example, doctors, nurses, and physiotherapists.

5. Evaluation of Student Achievement

At least 75 per cent of the term mark for this unit is to be based on students':

a) cooperation with a laboratory partner when performing the dissection;

b) laboratory reports and labelled diagrams at various stages of the dissection;

c) practical laboratory tests using class specimens.

6. Safety Considerations

a) Protective eyewear and disposable gloves should be worn during the dissection.

b) Students should wash their hands thoroughly with soap before leaving the lab.

c) Specimens should be rinsed in water prior to use.

d) Appropriate ventilation should be provided during the dissection.

7. Possible Extensions

Some students might do a comparative anatomical survey of other vertebrates such as a leopard frog, snake or bird.

8. Some Teaching Suggestions

a) The following sequence of stages can be used to perform the dissection in a logical progression: external features and integuments; mouth region; ventral dissection through the thoracic trunk and abdomen to investigate the digestive, excretory, reproduction, circulatory and respiratory systems; dorsal dissection of the spinal column noting neural and blood vessel association.

b) Detailed terminology should be avoided. It is of greater importance that students appreciate the overall scheme of the body, understand common disorders and their location, treatment and possible cause, and understand the interrelationship between selected structures.

c) Labelled sketches are helpful for reviewing dissected areas. Students should be encouraged to use these as opposed to copying printed technical drawings. These sketches should be accurate but need not be artistic.

d) Students should constantly be reminded that the mammal being dissected is acting as a model upon which analogies to the human body can be drawn.

e) Comparison to other mammals at various stages of dissection can be useful in noting physical adaptations and the uniqueness of species in performing different functions well (e.g., contrast teeth of the human, rat, beaver, sheep and horse).

f) Those systems not covered in detail in specific units, may require greater guidance and instruction during dissection.

g) A laboratory manual which uses simplified terminology and outlines an appropriate sequence for doing the dissection can be helpful to students.

Optional Unit 5: Humans and the Environment   Time: 12 h

Ecology is the study of relationships between living organisms and their environment. Human activities during the past century have forced us to recognize that people live as a biotic part of, not apart from, the environment. The development of ecological issues during the recent past has placed all individuals into a position where the impact of humans on the environment simply cannot be ignored. The individual's internal homeostasis allows for compensation of a wide variety of "inputs". However output from a large number of individuals must be compensated for by the environment's homeostatic adjustments or an environmental crisis will result.

This unit may be divided into topics such as the following:

- Matter, energy and population growth
- North American food consumption
- Food and the third world nations
- Homeostasis in the ecosystem
- Waste disposal site selection
- Recycling
- Global ecological issues
- Local environmental and ecological issues

1. Objectives

Attitudes. Students will be encouraged to develop:

a) critical mindedness in examining various sides of an ecological issue (2d);

b) an appreciation that solutions to environmental problems involve contributions from many subject areas (e.g., science, economics, sociology);

c) a respect for the fragile ecological balance of components of the ecosystem;

d) a questioning attitude towards the reporting of ecological events by the various media (2d, 3a);

e) a commitment to reduce personal garbage and to make better use of our natural resources (2b);

f) a concern for existing wildlife areas and a commitment to the preservation of ecologically unique areas (2g);

g) critical mindedness in extrapolating exponential curves and realizing that such curves are only projections and have restricted use (2b).

Skills. Students will have the opportunity to develop skill in:

a) graphing and interpreting exponential curves using data from a geometric growth activity (2a);

b) inferring future population and consumption trends from extrapolating graphs (2a);

c) predicting the possible effects of ecological changes on the environment (2e);

d) locating information about and debating local environmental issues (2f, 2g);

e) collecting statistics for a variety of ecological problems on topics such as population, consumption, and production (2b, 2e);

f) oral or written proficiency in reporting results of research to the class (2c, 2e));

g) listening objectively to the views of other students.

Knowledge. Students will be expected to:

a) outline the meaning of the terms: ecology, homeostasis, ecosystem, niche, biotic, abiotic, carrying capacity, exponential, acid rain, recycle;

b) identify local environmental issues (2c, 2f, 2g);

c) recall that humans have the ability to improve the quality of their lives by improving the quality of their environment (2c, 2b);

d) give reasons why the quantity of matter and available energy cannot keep pace with present population growth (2b);

e) describe the growth rate of global human population (2b);

f) describe the waste produced by individuals and relate this to pollution which affects the environment (2c);

g) demonstrate how environmental abuse can upset the homeostasis of the ecosystem and threaten the quality of life (2e);

h) describe the complexity of an environment issue involving a variety of interrelated factors (2f, 2g);

i) describe how environmental standards are set by and monitored by a variety of governmental agencies and relate this to concerned and informal pressure from voters and lobby groups.

2. Student Activities

Students are to:

*a) prepare and compare two graphs on the results of doubling of a penny each year for 35 years and on world population statistics from the year 500 A.D. to the present (8a);

b) (i) make a list of the variety and quantity of food they have consumed in a single day and using world population statistics estimate the quantity of animals and plants consumed in a single day if the entire world ate at Canadian standards;

(ii) estimate the quantities of water, iron and steel, petroleum and food used by the average North American in a lifetime; compare this figure to the quantities of wastes discarded in a lifetime such as kilograms of garbage, cans, and automobiles; apply these statistics to any third world nation and draw conclusions about the effect on the environment if a third world nation imitated a North American standard of living (8b);

(iii) draw conclusions about the effect on the environment if North Americans reduced their standard of living to that of a typical third world nation (8b);

c) (i) prepare a list of a variety of industrial wastes produced from a number of local industries; (ii) discuss the various issues that revolve around the selection of an appropriate waste disposal site, for example, the needs for the site, transportation to the site, and the ecological problems involved in site selection (8c);

d) examine and discuss both sides of the seal harvest controversy including the economic aspect as well as the ecological impact on fisheries of an unchecked growing seal population;

*e) conduct a library research project on one of the following and project the effects on the environment to the year 2050:
the greenhouse effect caused by an increase in carbon dioxide, a decrease in photosynthesis caused by the removal of Northern and Tropical forests, pollution of the oceans, the effect of uncontrolled acid rain on the world's forests, case studies of a particular pollution incident, such as a chemical spill (8h);

f) examine both the economic and the ecological needs of the area as it relates to a local environmental issue (8e, 8f, 8g);

*g) select a local area that students feel is environmentally sensitive or unique and prepare a report that would contribute to zoning the area as parkland or public open space after examining both the needs of industry and the need for preservation (8f, 8g).

*See the subsection entitled "Student Activities" on page 10.

3. Applications

a) Environmental issues, both locally and on the global scale, are constantly in the media. Individual efforts are cumulative and add to the ability to solve larger problems.

b) Garbage, whether produced by the individual or industry, is a problem that concerns every citizen. A reduction in unnecessary garbage will lower total clean up costs.

4. Societal Implications

a) North American lifestyles strain the world ecological balance and may result in shortages of many natural resources.

b) Projections indicate that certain global problems will be a concern to all of society. Reduction or elimination of these problems will benefit all of society.

c) Environmental issues always have many sides. By considering all sides of the issue, rational and logical decisions may be implemented.

5. Evaluation of Student Achievement

At least 40 per cent of the term mark for this unit is to based on students':

a) library research projects

b) preparation and interpretation of graphs of a geometric growth activity.

6. Safety Considerations

Not applicable in this unit.

7. Possible Extensions

Some students might:

a) study the effects of bringing third world countries up to North American standards of consumption of metals and petroleum;

b) examine how science is attempting to cope with exponential demands for food by developing so called "miracle foods" and rapid growing crops;

c) examine the role and effectiveness of a variety of environmentally concerned groups.

8. Some Teaching Suggestions

a) Appropriate scales on graphs should be used if students are to compare the relationship between two exponential growth curves.

b) Teachers should be aware that some students may be sensitive in discussions involving certain third world nations. The problems of giving third world nations opportunities to improve their standard of living are complex and very demanding on the biosphere.

c) Simulations of local environmental issues should include a problem solving model approach, with decision making involving all sides of the issues.

d) Homeostasis within the individual contributes to the survival of that individual and has been considered during the physiology units. Homeostasis within the ecosystem is also necessary for survival and teachers can use examples of where interference by man in a natural ecosystem has upset the balance leading to a potential collapse.

e) Localized air pollution can lead to a temporary greenhouse effect in major urban areas.

f) A presentation to a local municipal government can follow research on rezoning of a local ecological site.

g) If an environmental issue appears at a local municipal council meeting, students can go to the council meeting to critically examine the debate.

h) Relevant data for use and research is easily available from a wide variety of government publications as well as library resource materials.

Optional Unit 6: Behaviour and the Central Nervous System   Time: 6 h

The task of assimilating the sensory input to our bodies resides in the central nervous system. The product of this assimilation can be described as output, or behaviour. Although human behaviour is one of the least understood sciences, students can acquire a basic knowledge so that they may begin to understand the reasons for human behaviours.

Sensory input is one of the components that may stimulate learning. As a result of learning an organism may alter aspects of its behaviour. Knowledge and use of effective learning techniques can result in greater personal success.

Personality disorders are common. However, many of these disorders are not readily recognized. Recognition of these disorders may lead to treatment and greater personal happiness. Acceptance of the mentally ill is more likely when we are aware that this illness is often an organic disorder.

An understanding of the occurance, avoidance and treatment of central nervous system injuries is valuable.

This unit may be divided into topics such as the following:

- Reflex
- Coordinated response of invertebrates

- The central nervous system
- Drives
- Instincts
- Learning techniques and disorders
- Abnormal personalities
- Effect of drugs on the central nervous system and behaviour

1. Objectives

Attitudes. Students will be encouraged to develop:

a) an appreciation of the complexity of the nervous system;

b) respect for the care of live specimens (2a);

c) curiosity in examining behaviour patterns (2a, 2d);

d) critical-mindedness in choosing and applying knowledge of good learning environments and study techniques (3c);

e) an empathy for individuals with abnormal personalities and learning disorders (3e, 4b, 4c);

f) concern for the avoidance of spinal cord and brain injuries (3a, 4b).

Skills. Students will have the opportunity to develop skill in:

a) observing various behaviours;

b) handling live specimens appropriately (2a);

d) classifying behaviour as a reflex, or a coordinated response requiring brain involvement (2a, 2b);

e) classifying behavioural drives;

f) inferring, from various learning laboratories, proper study habits (2e);

g) inferring from observation, the adaptive value of coordinated responses of invertebrates (2a).

Knowledge. Students will be expected to:

a) describe the structure and physiology of the neuron, a synapse and the reflex arc (2b);
b) identify the protective structure and mechanisms of the brain and spinal cord;
c) outline the cause and effect of physical trauma to the brain and spinal cord;
d) describe the effects of some disorders of the central nervous system (e.g., strokes, meningitis, cerebral palsy, spina bifida, multiple sclerosis);
e) identify the basic structures and functions of the vertebrate brain (2c);
f) state the basic human drives and outline their adaptive significance (2d);
g) recall some instinctive vertebrate behaviours and state their adaptive significance (2d);
h) identify some examples of effective learning techniques (2e);
i) identify the potential causes, symptoms, and accepted treatment, where possible, for various personality disorders (e.g., phobias, obsessions, compulsions, kleptomania, psychopathy, drug abuse, Alzheimer's disease, senility, depression, schizophrenia, paranoia);
j) identify the symptoms and possible treatment of various learning disorders;
k) describe the types and effects of various medical and

non-medical drugs;

l) describe the relationship between normal individual behaviour and influence of peers, crises or a large group.

2. Student Activities

Students are to:

*a) (i) observe coordinated responses in invertebrates, such as an earthworm to darkness and bright light;
  (ii) observe the response of an earthworm to ammonium hydroxide fumes (6a);

*b) observe various reflexes such as:
  (i) the constriction of the pupil when a dark-adapted eye is subjected to bright light;
  (ii) the blinking of the eye in a startled response;
  (iii) the familiar knee jerk reflex;

c) dissect a preserved sheep brain and/or a dorsal cranial section of a vertebrate (6b);

d) do a library research project to investigate examples of instinctive behaviour such as communication in honey bees, bird migration, mating behaviour of the stickleback, nest building in birds, or spinning of the spider's web (8b);

*e) participate in at least 3 of the following exercises:
  (i) a conditioning experiment;
  (ii) an experiment to demonstrate how memory is related to habits;
  (iii) a nonsense learning exercise;
  (iv) a learning with distraction exercise;
  (v) a trial and error exercise;

(vi) a data base exercise;

(vii) an experiment to investigate three sensory routes to learning (aural, visual, tactile) (8d-8h);

f) conduct a library research project on examples of and treatment for one of mental illness, central nervous system injuries, or learning disorders.

*See the subsection entitled "Student Activities" on page 10.

3. Applications

a) Brain and spinal cord injuries can have a profound debilitating effect. Recognition of their cause and avoidance are vital.

b) The early recognition and treatment of any learning or behaviour disorder is beneficial to the individual.

c) It is important to recognize proper personal study techniques as a component for success.

d) Success at school results in an improved measure of the student's self worth.

e) Through a knowledge of mental illness, students may be more sympathetic to those with mental disorders and accept them as full members of society.

4. Societal Implications

a) Early recognition of and treatment for any disorder reduces loss of school and work time and health care costs.

b) Individuals with brain or spinal cord disorders, or the mentally ill can be valuable contributing members of our community.

c) Acceptance of group homes in a community could result from better understanding of mental illness and disorders.

d) Many careers in the health field exist for individuals with interest in learning disabilities, brain and spinal cord injuries, and mental illness.

5. Evaluation of Student Achievement

At least 50 per cent of the term mark for this unit is to be based on students':

a) observations of behaviours from the learning laboratories;

a) laboratory reports;

6. Safety Considerations

a) Hands should be washed after working with live and preserved specimens.

b) Gloves and protective eyewear should be worn during dissections.

7. Possible Extensions

Some students might:

a) research, or perform experiments to determine, coordinated responses of other invertebrates (e.g., avoidance reactions of Planaria to light, attraction of Drosophila or Euglena to light);

b) perform experiments to determine tropisms in plants;

c) do a library research project on the various reflexes and their adaptive value in the newborn;

d) assist a learning resource teacher;

e) do a library research project on the influences of stress on physiology and behaviour.

f) observe films or videotapes demonstrating the behaviour of individuals in large groups.

8. Some Teaching Suggestions

a) Teachers should be very sensitive to the students in the class who may have had personal contact with an individual with a personality disorder.

b) Many excellent films on animal behaviour are available.

c) A representative of the Mental Health Society, local Health Unit, a psychiatrist or psychologist, a representative from Alcoholics Anonymous, Al-Anon, Al-Ateen, or Addiction Research Foundation can be invited to be a guest speaker.

d) Conditioning can be demonstrated in the following manner: the teacher standing at the back of the room, out of sight of the students, can ask students to tally the number of times he/she utters a word providing an auditory cue at the same time the word is spoken (for example, tap a desk with a ruler). This is continued until finally the desk should be tapped without uttering a word. Many students will tally the tap as if a word was spoken.

e) The relationship of memory and habit can be demonstrated in the following ways: students can be asked to name all of the streets, or the names of all of the stores they pass by on their way to school; a blind-folded student can be asked to explain to another student how to tie a bow.

f) Nonsense learning can be demonstrated by providing the students with the following lists:

Column A	Column B
shall	I
see	think
poem	that
as	I

tree
think
I
never
a
lovely
a
I
that

shall
never
see
a
poem
lovely
as
a
tree

Students can be asked to memorize each of the two columns in a given amount of time and the results can be compared.

g) Learning with distraction can be demonstrated in the following manner: students can be asked to memorize some material such as random numbers in a quiet environment. The exercise can be timed. Students can then be asked to memorize a comparable amount of material (different but similar type of random numbers) only this time with some distractions and the results can be compared.

h) Learning by trial and error can be demonstrated by providing each student with four pieces of paper that conform to the exact shape illustrated below:

These four shapes, when placed together in a specific orientation, make up a perfect square. Students can be asked to time how long it takes them to achieve the correct orientation. After this is done, the shapes can be collected. After a short period of time, the shapes can be redistributed and the students can repeat the exercise.

i) Teachers should demonstrate that large volumes of information may be organized in such forms as tables, graphs, charts.

j) It is not the intent of this course to have students memorize anatomical names and functions of parts of organisms in great detail. Only the major part of the brain should be identified if a dissection is done.

Optional Unit 7: Locally Designed Unit

Time: 6 or 12 h

This unit is to be designed at the local level as desired. It can be used to introduce a new area or topic of science not described in this guideline or to incorporate additional objectives that will expand a previous part or parts of the course. The time chosen for this unit should be such that when combined with the other opional units a total of 24 h is allocated. Examples of new areas or topics that might be considered include:

The endocrine system
Careers in the life science
Humans and invertebrates
Microbiology
Ecological relationships
The diversity of organisms

This unit may provide an excellent opportunity for students to engage in independent study on a topic in biology that is of particular interest and that is approved, monitored, and evaluated by the teacher. Students may work individually or in small groups. Care should be taken to not allow the work to overlap with subject matter in other science courses that the students are likely to take. The unit could be started after the students have had some experiences in the laboratory and are well aware of accident prevention. If a series of short topics are considered they may be fitted into the course schedule from time to time throughout the semester or year.

It is expected that the local design of this unit will incorporate components similar to those adopted in the core units, namely, objectives, student activities, applications, and societal implication. An outline of the unit is to be included with the school's course of study and kept on file so that it is available to interested students and parents.

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